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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : CANNON
 Serial No : 09/866,400
 Confirm. No : 6238
 Filed : May 25, 2001
 For : APPARATUS AND METHOD...
 Art Unit : 2877
 Examiner : Pham, H.
 Dated : November 7, 2002

Hon. Commissioner of Patents
 and Trademarks
 Washington, D.C. 20231

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TECHNOLOGY CENTER 2800

AMENDMENT

In response to the Office Action dated May 7, 2002, please amend the above-identified application as follows:

IN THE CLAIMS:

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Not changed by this Amendment and remains as follows:

1. An apparatus for the visual inspection of soldered joints between an electric or electronic component disposed on the surface of a printed circuit board and the printed circuit board, the apparatus comprising:

an ocular unit;

a lens head;

an image transmission unit for transmitting the image received by said lens head to said

ocular unit; and

an illuminating device for illuminating the soldered joints to be inspected, said lens head comprising a device for image deflection extending up to an axially outermost end of said lens head, said illuminating device being disposed in said lens head to provide a light exit directed toward the soldered joints to be inspected, said light exit being disposed besides said device for image deflection at the axially outer end of said lens head.

Claim 2 has not been changed by this Amendment and remains as follows:

2. The apparatus according to claim 1, wherein said light exit of the light of the illuminating device from the lens head is a bilateral exit next to the device for image deflection.

Claim 3 has not been changed by this Amendment and remains as follows:

3. The apparatus according to claim 1, wherein the device for image deflection comprises at least one deviating prism or at least one deviating mirror.

Claim 4 has not been changed by this Amendment and remains as follows:

4. The apparatus according to claim 1, wherein the deviation angle of the device for image deflection is between 0 and 180 degrees.

Claim 5 has not been changed by this Amendment and remains as follows:

5. The apparatus according to claim 4, wherein the deviation angle of the device for image deflection is substantially 90 degrees.

Claim 6 has not been changed by this amendment and remains as follows:

6. The apparatus according to claim 1, wherein the lens head has a focal length such that the depth of field area of the image corresponds to at least half of a largest component size of the component on the printed circuit board.

Claim 7 has not been changed by this amendment and remains as follows:

7. The apparatus according to claim 1, wherein the lens head comprises a housing with at least one laterally open recess tapering towards the axially outer end of the lens head and bounded on both sides by flange-type webs, wherein a deviating prism or deviating mirror is disposed in the housing to cause a free surface of the deviating prism or the mirror surface in the recess faces outwards and the lower lateral edge of the deviating prism or of the deviating mirror seals the lens head towards the axially outer end, and wherein further the light exits of the illuminating device are arranged in the flange-type webs.

Claim 8 has not been changed by this amendment and remains as follows:

8. The apparatus according to claim 1, wherein the illuminating device comprises at least one glass fiber bundle with first and second ends, said first axial end is connectable to a light source and forms with said second axial end the light exit of the illuminating device on the lens head.

Claim 9 has not been changed by this Amendment and remains as follows:

9. The apparatus according to claim 1, wherein the image transmission unit comprises at least one glass fiber bundle which is optically couplable with its first end to the unit for image

deflection, and with its second end to the ocular unit.

Claim 10 has not been changed by this amendment and remains as follows:

10. The apparatus according to claim 1, wherein a second illuminating device, positionable substantially in a viewing direction of the apparatus opposite the lens head, illuminates in the direction of the lens head.

Claim 11 has not been changed by this amendment and remains as follows:

11. The apparatus according to claim 10, wherein the second illuminating device comprises a counterlight head with a housing with at least one laterally open recess tapering towards the axially outer end of the counterlight head, wherein in the housing a deviating prism or a deviating mirror, which is optically couplable to a light source via a glass fiber bundle, is disposed with the free surface of the deviating prism or the mirror surface in the recess facing outwards and the lower lateral edge of the deviating prism or of the deviating mirror seals the counterlight head towards the axially outer end.

Claim 12 has not been changed by this amendment and remains as follows:

~~13~~ 12. The apparatus according to claim 10, wherein the second illuminating device comprises a counterlight head which is of substantially identical construction to the lens head.

Claim 13 has not been changed by this amendment and remains as follows:

~~14~~ 13. The apparatus according to claim 10 wherein the glass fiber bundle at least of the second

illuminating device runs in a flexible spiral tube.

Claim 14 has not been changed by this amendment and remains as follows:

12 ~~14.~~ The apparatus according to claim 11, wherein the glass fiber bundle of the lens head and of the counterlight head are connectable to the same light source.

Claim 15 has not been changed by this Amendment and remains as follows:

15. The apparatus according to claim 10, wherein the lens head and the second illuminating device are couplable via a linkage or rack to provide an exactly defined relative position of lens head and second illuminating device is adjustable.

Claim 16 has not been changed by this amendment and remains as follows:

16. The apparatus according to claim 15, wherein the linkage or rack comprises a freely projecting bracket which is fixable substantially rigidly to a housing section of the apparatus between lens head and ocular unit or is part of the housing section, wherein the bracket comprises, displaceable in longitudinal direction in a guide element, a holding device in which the second illuminating device is fixable, with which the axial distance between lens head and counterlight head is adjustable.

Claim 17 has not been changed by this Amendment and remains as follows:

17. A method for checking the quality of the soldered joint between an electric or electronic component disposed on the surface of a circuit board including an SMD, BGA, CSP or FC

component, and the circuit board, the method comprising the steps of:

5 using an ocular unit with an apparatus including a lens head, an image transmission unit for transmitting the image received by the lens head to the ocular unit and an illuminating device for illuminating the soldered joints to be tested, in which the lens head comprises a deviating prism for image deflection which extends up to the axially outermost end of the lens head, and in which the illuminating device is disposed in the lens head to cause the exit angle of the light of the illuminating device out of the lens head is substantially equal to the deviation angle of the image deflection and
10 the exit point of the light is disposed next to the deviating prism for image deflection in the area of the axially outer end of the lens head, the component comprising, arranged in rows and gaps after the manner of a matrix, a large number of solder pins, solder balls or solder points which are solderable with a corresponding number of contact points complementary as to shape and function disposed on the printed circuit board;

15 visually examining the soldered joints of the outermost row of soldered joints of a first side of the component to be tested with the ocular unit, wherein the component is moved step-wise according to the spacing of the solder joint rows or gaps past the lens head of the ocular unit or, conversely, the lens head of the ocular unit is moved step-wise past the component;

20 rotating of the component or the ocular unit through respectively 90 degrees and visually examining the soldered joints of the outermost rows of soldered joints of the further sides of the component with the ocular unit wherein the component is moved step-wise according to the spacing of the solder joints past the lens head of the ocular unit or, conversely, the lens head of the ocular unit is moved step-wise past the component; and

visually examining the channels formed between the respective gaps or rows for optical

25 visibility.

Claim 18 has not been changed by this amendment and remains as follows:

13. The method according to claim 17, wherein said visually examining the channels is performed with a counterlight.

Claim 19 has not been changed by this Amendment and remains as follows:

19. The method according to claim 17, wherein in addition to said visually examining the soldered joints and said rotating the soldered joints of the inner rows are examined visually for soldering defects by viewing into the channels formed between the gaps or rows.

Please amend claim 20 as follows:

20. (TWICE AMENDED) An apparatus for the visual inspection of soldered joints disposed between an electric or electronic component and a substrate, the apparatus comprising:

an ocular unit;

a lens head;

an image transmission unit for transmitting the image received by said lens head to said ocular unit, said ocular unit, said image transmission unit and said lens head being connected to form an assembly with said lens being at an end of said assembly to define an axial extent of said assembly; and

an illuminating device for illuminating the soldered joints disposed between the electric or electronic component and the substrate, said lens head comprising an image deflection device for

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changing the direction of the image path from an incoming direction from between the electric or electronic component and the substrate to an outgoing direction, said image deflection device extending up to an axially outermost end of said lens head and up to said axial extent of said assembly, said illuminating device having a light exit to provide a light exit direction substantially toward said incoming direction, said light exit of said illuminating device being disposed circumferentially besides said device for image deflection.

Claim 21 has not been changed by this Amendment and remains as follows:

21. The apparatus according to claim 20, wherein said image deflection device changes the direction of the image path by an image deflection angle, said illuminating device having a light source and a light transmission path changing the direction of light from said light source to said light exit by an angle substantially equal to said image deflection angle.

Please amend claim 22 as follows:

22. (TWICE AMENDED) A visual inspection apparatus comprising:

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an image transmission unit having a longitudinal axis with first and second ends at opposite longitudinal ends, said image transmission unit transmitting an image from said first end to said second end along said longitudinal axis;

5 a head arranged at said first end of said image transmission unit, said head extending a predetermined distance from said first end of said image transmission unit;

an image deflection device arranged in said head and being receivable of an external image at an image axis angularly spaced from said longitudinal axis of said image transmission unit, said

image deflection device being feedable of the external image into said first end of said image
10 transmission unit substantially along said longitudinal axis, said image deflection device being
receivable of the external image at substantially a farthest longitudinal distance of said head from
said image transmission unit;

an illuminating device in said head, said illuminating device emitting light substantially parallel to said image axis at a longitudinal position of said image deflection device.

Claim 23 has not been changed by this Amendment and remains as follows:

23. An apparatus in accordance with claim 22, wherein:

said image deflection device is receivable of the external image over a longitudinal image distance;

said illuminating device emits the light at a position within said longitudinal image distance.

Claim 24 has not been changed by this amendment and remains as follows:

24. An apparatus in accordance with claim 23, wherein:

said longitudinal image distance has one longitudinal end at said farthest longitudinal distance of said head;

said illuminating device emits the light at a position adjacent said farthest longitudinal distance.

Claim 25 has not been changed by this Amendment and remains as follows:

25. An apparatus in accordance with claim 22, wherein:

said head includes a web longitudinally extending along one side of said image deflection device, said web extending to said farthest longitudinal distance.

Claim 26 has not been changed by this Amendment and remains as follows:

26. An apparatus in accordance with claim 22, wherein:

said head includes a web longitudinally extending along one side of said image deflection device, said web extending substantially to said farthest longitudinal distance.

Claim 27 has not been changed by this Amendment and remains as follows:

27. An apparatus in accordance with claim 25, wherein:

said head includes another web longitudinally extending along another side of said image deflection device, said another web extending to said farthest longitudinal distance.

Claim 28 has not been changed by this amendment and remains as follows:

28. An apparatus in accordance with claim 27, wherein:

each of said webs define an opening for emitting light from said illuminating device.

REMARKS

Claims 1 - 28 are in this application and are presented for consideration. By this Amendment, Applicant has made a minor formal correction to claim 22. Additionally, Applicant has revised claim 20 to further highlight aspects of the invention.

The Examiner has rejected claim 22 as being indefinite. Applicant has now corrected the

claim such that this rejection has been overcome.

Claims 22 - 28 have been rejected as being anticipated by DE GM 74 40 701. The Examiner takes the position that each feature claimed is disclosed by DE'701.

Applicant attaches hereto an excerpt from DE'701 (ATTACHMENT A), namely Fig. 2 wherein Applicant has added reference symbol "D" showing a distance from an image deflection device to a farthest longitudinal distance of the head of the device to the transmission unit. This feature, an important feature of Applicant's invention, is completely missing in DE'701.

The DE'701 reference clearly describes exactly the state of the art which is explained in the introductory portion of the present application text. As can be seen from Fig. 2 of the DE'701 reference, the image deflection device 3 is located at a substantial distance from the axially outer most end of the endoscope or lens head, respectively. In this regard it is requested that the Examiner again consider this distance "D" as shown on the (ATTACHMENT A), the annotated version of Fig. 2. Furthermore, the illumination devices 9, on both sides of the image deflection device, extend in a region below the image deflection device. This differs from Applicant's claim 22 which highlights the provision of an illuminating device. Based on the defined elements of the combination as claimed in claim 22 the DE'701 reference cannot anticipate the structure with regard to the illuminating device claimed. Specifically the claim indicates that the illuminating device emits light substantially parallel to an image axis at a longitudinal position of the image deflecting device. This entails that the illuminating device cannot be significantly offset, namely cannot be disposed significantly lower than the lowermost edge of the deflecting device. Further, the claim indicates that the image deflection device is at the furthest distance from the transmission unit such that the claim either requires the illuminating device is substantially at the same axial extent as the image deflection device or near to this. Clearly DE'701 fails to teach the structural features as claimed. Further, as a consequence of this failure to teach the structure combination as claimed, the device

of DE'701 does not allow the user to place the lens head in a position such that the image deflection device may "look" into a small gap (for example smaller than the distance "D" of the image deflection device 9 from the outer most end) between for example a BGA and a substrate. Thus accordingly the DE'701 reference clearly does not anticipate claims 22 - 28 of the present application. Reconsideration of the rejection is requested.

Claims 1 - 9 and 20 - 21 have been rejected as being obvious based on DE'701 in view of Woo et al.. It is Applicant's position that the references together fail to teach and fail to suggest the combination of features claimed.

In the rejection as to claims 1 and 20 the Examiner focuses on the intended use as to inspecting solder joints. Applicant notes that it would not be obvious to use this as the device could not be useful as noted immediately above. More importantly the references clearly fail to teach the structural combination of features as claimed.

As indicated above, DE'701 fails to teach important features of the invention. With regard to claim 1 the reference clearly fails to teach an image deflection device which extends up to an axially outermost end of the lens head. Similar features are present in claim 20 and DE'701 clearly fails to teach this.

Woo et al. describes an optical instrument which is not an endoscope but a microscope. This is significant with regard to the allegation that the subject matter is obvious. In Woo there is no image deflection at all. Accordingly, there is no possibility to inspect gaps between an electronic device and a substrate. With no image deflection device it is not clear how the Woo et al. reference provides any teaching or suggestion which would lead the person of ordinary skill in the art based on the teachings of DE'701 toward the structure of the invention.

The Woo et al. reference does teach an annular illuminating device which circularly encloses a lens head. From this teaching it can be appreciated that this is not going to provide the person of ordinary skill in the art with motivation or incentive to depart from DE'701 and provide the

combination as claimed in independent claims 1 and 20. Even if one would argue that the lens head from Woo could be horizontally disposed to look into a gap like the present invention, the lens 36 could not be placed directly on the substrate (a lower surface) as it is not at an axial end in any way of looking at the structure. The structure would always have an annular illumination device between any lower end and the lens structure (see ATTACHMENT B the annotated Fig. 7 showing a distance D). Accordingly, the references as a whole direct the person of ordinary skill in the art away from the invention and fail to teach and fail to suggest the combination of features claimed. Woo et al. does not provide any hint or suggestion of the person skilled in the art to change the endoscope of the DE'701 reference and to provide the features as claimed. There is absolutely no suggestion to provide an image deflection device extending to an outermost end of the lens head.

Claims 1 - 9 and 20 - 28 have also been rejected as obvious based on Tagami (U.S. 5,170,775) in view of Oku (U.S. 4,277,168) and Woo et al. (U.S. 6,023,368).

Tagami describes an endoscope which corresponds more or less to the endoscope of the DE'701 reference. As can best be seen in Fig. 1 (SEE ATTACHMENT C), an illuminating window 20 of an illuminating device is arranged between the outermost end of the endoscope and a deviating prism 23. This structure fails to suggest the structure claimed in the independent claims. Accordingly, the endoscope of Tagami may not be used to inspect a gap between a substrate and an electronic device smaller than the distance "D" as shown in the annotated version of Fig. 1 of Tagami as attached (ATTACHMENT C). The references direct a person of ordinary skill in the art to a construction which is different from the invention and the invention as claimed provides more than any combination which may be suggested. Woo et al. does not provide a hint or suggestion as noted above.

The Oku reference discloses an endoscope with an image deflecting device in the form of a prism and an observing window 4. In contrast to Tagami, the illustrating device 7 is above the observing window 4 and not between the observing window 4 in the outermost end of the endoscope

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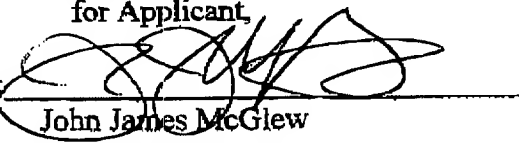
or lens head, respectively. However, as can be appreciated from annotated Fig. 2 (ATTACHMENT D) attached Oku also fails to teach important features of the invention. As can be appreciated from Fig. 2 the observing window does not extend to the outermost end and instead there is a gap "D". It is not possible to inspect structures that are in the region smaller than this distance "D". Accordingly, the structural features claimed are not suggested by any of the prior art cited and the invention provides benefits which are not attainable from the prior art as a whole.

Applicant respectfully requests that the Examiner consider discussing this case with Applicant at a time that is convenient for the Examiner. As the invention includes features which are not disclosed by the prior art, it is Applicant's position that some wording should be acceptable to define the patentable subject matter. In particular, it is hoped that such a discussion with the Examiner can discuss the claim language with regard to how it defines over the prior art.

Further and favorable action on the merits is requested.

Respectfully submitted
for Applicant,

By:


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Enclosed:

Marked-Up Version of the Claims
Excerpt from DE'701 - Attachment A
Excerpt from US'368 - Attachment B
Excerpt from US'775 - Attachment C
Excerpt from US'168 - Attachment D
Petition for Three Month Extension of Time

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DATED: November 7, 2002
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SHOULD ANY OTHER FEE BE REQUIRED, THE PATENT AND TRADEMARK OFFICE IS HEREBY REQUESTED TO CHARGE SUCH FEE TO OUR DEPOSIT ACCOUNT 13-0410.

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MARKED-UP VERSION OF THE CLAIMS

20. (TWICE AMENDED) An apparatus for the visual inspection of soldered joints disposed between an electric or electronic component and a substrate, the apparatus comprising:

an ocular unit;

a lens head;

5 an image transmission unit for transmitting the image received by said lens head to said ocular unit, said ocular unit, said image transmission unit and said lens head being connected to form an assembly with said lens being at an end of said assembly to define an axial extent of said assembly; and

10 an illuminating device for illuminating the soldered joints disposed between the electric or electronic component and the substrate, said lens head comprising an image deflection device for changing the direction of the image path from an incoming direction from between the electric or electronic component and the substrate to an outgoing direction, said image deflection device extending up to an axially outermost end of said lens head and up to said axial extent of said assembly, said illuminating device having a light exit to provide a light exit direction
15 substantially toward said incoming direction, said light exit of said illuminating device being disposed circumferentially besides said device for image deflection.

22. (TWICE AMENDED) A visual inspection apparatus comprising:

an image transmission unit having a longitudinal axis with first and second ends at opposite longitudinal ends, said image transmission unit transmitting an image from said first end to said second end along said longitudinal axis;

5 a head arranged at said first end of said image transmission unit, said head extending a predetermined distance from said first end of said image transmission unit;

an image deflection device arranged in said head and being receivable of an external image at an image axis angularly spaced from said longitudinal axis of said image transmission unit, said image deflection device being feedable of the external image into said first end of said
10 image transmission unit substantially along said longitudinal axis, said image deflection device being receivable of the external image at substantially a farthest longitudinal distance of said head from said image transmission device unit;

an illuminating device in said head, said illuminating device emitting light substantially parallel to said image axis at a longitudinal position of said image deflection device.

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